Development of a Quantitative Habitat Analysis Planning System

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Abstract

Quantitative Habitat Analysis (QHA) is a multi-faceted management, modeling, and planning system. This report will cover the pilot study conducted during FY00. QHA is currently comprised of five main models that will be analyzed within GIS: 1) Ecological Land Classification, 2) Rapid Ecological Assessment (for general assessment)/USNVC Element Occurrence (for ecosystem "health"), 3) BEHAVE wildfire and fuels monitoring, 4) Habitat Analysis and Modeling System (for wildlife), and 5) ECORSK.5 (for bio-contaminants). Study sites were placed on Bandelier and LANL properties in ponderosa pine and piñon-juniper habitats. In both habitat types a control (treated or "desired future state") site and an experimental (non-treated or disturbed state) site were selected. The following methods were field tested: Rapid Ecological Assessment/The Nature Conservancy (vegetation and fauna); Gentry Method (vegetation); Dallmeier Method (vegetation); Modified Whittacker (vegetation); and Vegetation and Fuels Method (fuels and vegetation). Summaries of data collected and methodologies were compared, and a "common currency" for analysis results was developed. Ultimately, the QHA model will be useful to all natural resource managers in the region.

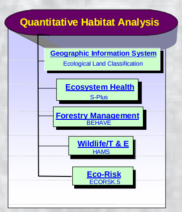


Figure 1. Components of QHA systems, where connecting lines represent "Common Currency"

Introduction

Quantitative Habitat Analysis (QHA) is a system for habitat evaluation being developed for use at LANL. Habitat, ecosystem, conservation, or biological assessments have been used in various ways by many universities, federal agencies, and public organizations to determine the vulnerability of a habitat or species within a region. They each operate with different definitions, calculations, and values for natural resources from one organization to the next. Thus, each organization may provide different outcomes and recommendations based primarily on subjective classifications.

A QHA that provides an objective, standardized, replicable, and accessible system for accurately determining the direction of stewardship is necessary, not only for continued management of wild areas by federal agencies, but for all professionals working in the field. A system that is flexible and adaptable on many scales becomes necessary.

So why work within a new system? Why not just use an existing model? First, there was a need to satisfy a method for quantitatively comparing tracts of land on LANL. To accomplish this, we decided on a multi-use system for resource managers and researchers. Since no single model was robust enough alone, we decided to use many models to accomplish this goal (Fig. 1). We also have the challenge of creating a "Common Currency" or a method for all of the programs and models to create a common language of interpretation. For example, a site may rank favorably as habitat for an endangered species, favorably for general location for a suite of wildlife and plants, but poorly for contamination. Developing ranks for each condition as well as an overall score for each study site will be the ultimate goal.

QHA was developed by researching habitat models available on the web and literature searches for all federal, public, university, and non-profit information. In total, 54 models, assessments and computer programs were reviewed. QHA is a 3-year development project. In FY00 a pilot field study was conducted. In FY01 we will integrate the data collected from the pilot study to create a test program system within GIS and further refine the "Common Currency." And finally, in FY02 we will implement a full QHA with new field data and analysis with the model.

Methods

One of our primary goals for the pilot study was to test several field methods for vegetation data collection and to determine the most useful for our purposes. In each site, we had three plots. Our initial hypothesis was to have each plot be completely homogeneous with the next so that we could compare conditions of control and experiment more easily. Each plot was 20 m by 50 m and all methods were conducted within each of these plots (Fig. 2). A goal for selecting an appropriate field technique was one that could be done rapidly, efficiently, and accurately. We used four primary field techniques for comparison:

•The Gentry Method was an exploded 0.1 ha set of transects where all stems 2.5 cm or greater were sampled in ten 2 m by 50 m transects.

•The Dallmeier Method was two 20 m by 20 m subplots sampled for stems >10 cm dbh and two 10 m by 10 m subplots sampled for exact percent cover of all species.

•The Vegetation and Fuels Method, or VFM was actually a combination of techniques. There was only one 20 m x 20 m subplot sampled per plot, and the end sample varied. There were a number of measurements taken, but the primary ones were percent cover sampled in classes (e.g., 1% to 5%), dbh of trees >5 cm dbh, densiometer samples of the overstory, and soil depth analysis with a soil probe.

•The Modified Whittacker Method, used nationwide by the USGS, was a system of many different sized subplots. In addition to vegetation, we sampled rock, soil, litter, cryptogams, fecal material, and cultural remains, such as obsidian, sherds, or housing blocks. The subplots consist of ten 0.5 m by 2 m sampled for exact percent cover of all species and abiotics, two 2 m by 5 m subplots, and one 5 m by 20 m subplot. The remaining 20 m by 50 m plot were sampled for presence or absence of all species and abiotics.

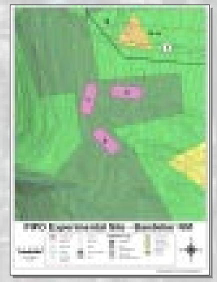


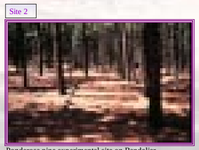
Figure 2. Example study plot layout, this one at Bandelier National Monument

Study Sites

Site 1

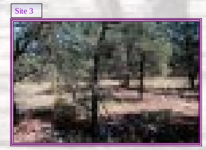
Ponderosa pine control site on LANL, where the trees were mechanically treated 1 to 2 years prior to the study.

Site 2



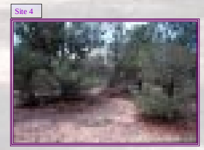
Ponderosa pine experimental site on Bandelier National Monument, where no treatment has occurred in the last 8 to 10 years.

Site 3



Piñon-juniper control site on LANL, where there was little erosion and good vegetation in the understory.

Site 4



Piñon-juniper experimental site on LANL, where there was high erosion and degradation.

Results

Table 1 is the relative density and dominance scores for ponderosa pine (*Pinus ponderosa*) in the experimental site at Bandelier and the control site at Highway 501. The Modified Whittacker method did not have a tree measurement component, so we summarized only Gentry, Dallmeier and VFM. Notice that the scores are all fairly similar. Only some variation occurs due to the dbh selected for each method and/or placement of the subplots. However, Table 2 shows the piñon pine (*Pinus edulis*) in the piñon-juniper study sites, where TA-49 is the control and DX is the experimental site. The differences in these data are more obvious because the habitat is more complex, thus changing the relative values for the single dominant species.

Table 3 shows the comparison of species richness across all sites and methods. The differences in the methods can be easily seen, especially between the Modified Whittacker and the others.

Method	Site	Relative Density	Relative Dominance
Gentry	Band	0.986	0.964
	501	0.978	0.988
Dallmeier	Band	0.993	0.996
	501	1.000	1.000
VFM	Band	1.000	1.000
	501	1.000	1.000

Table 1. Comparison of relative values for ponderosa pine *(Pinus ponderosa)* at the control and experimental sites.

Method	Site	Relative Density	Relative Dominance
Gentry	TA 49	0.456	0.593
	DX	0.564	0.569
Dallmeier	TA 49	0.618	0.641
	DX	0.523	0.529
VFM	TA 49	0.857	0.837
	DX	0.695	0.775

Table 2. Comparison of relative values for piñon pine (*Pinus edulis*) at the control and experimental sites.

Method	Site	Tree	Shrub	Forb	Grass	Cactus	Total
Gentry Transect	PJTA49	3	3	0	0	0	6
	PJDX	2	1	0	0	0	3
	PIPO501	2	0	0	0	0	2
	PIPOBAND	2	1	0	0	0	3
Dallmeier 20m x 20m & 10m x 10m	PJTA49	3	7	3	3	3	19
	PJDX	2	2	2	6	4	16
	PIPO501	4	3	7	7	0	22
	PIPOBAND	1	2	5	6	0	14
Modified Whittacker	PJTA49	3	6	19	9	3	40
	PJDX	2	4	8	9	4	27
	PIPO501	4	5	32	12	0	53
	PIPOBAND	3	4	12	13	0	32
VFM	PJTA49	2	5	7	3	3	20
	PJDX	2	4	3	2	1	12
	PIPO501	2	4	3	8	0	17
	PIPOBAND	4	2	2	6	0	14

Table 3. Species richness values for all methods in each site.

Conclusions

For continued work on QHA in the next phases, we plan to use the Modified Whittacker for vegetation and wildlife sampling, the Dallmeier Method for density of dominant tree species, and the VFM for soils and fuels sampling. We will be working in FY01 to further the use of our "Common Currencies" for better translation of the data into meaningful terms for comparing sites. QHA is a work in progress that will be flexible enough to meet the needs of many.

Acknowledgements

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